Clinicopathological Study on Left Ventricular Hypertrophy in Elderly Hypertensive Patients

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SUMMARY

The correlations between blood pressure, left ventricular hypertrophy and left atrial enlargement were examined in 2,010 autopsied cases. The cases were classified into 3 groups: 972 (48.2%) normotension cases, 313 cases (15.5%) of systolic hypertension and 725 cases (36.1%) of diastolic hypertension. The incidence of left ventricular hypertrophy (LVH) was significantly higher in systolic and diastolic hypertensive cases than in normotensives (p<0.05), but no significant difference in LVH incidence was found between the 2 hypertensive groups. The incidence of an enlarged left atrium was also significantly higher in both hypertensive groups than in the normotensive group (p<0.05). The incidence of congestive heart failure and a large CTR were also higher in both hypertensive groups. However, there were no intergroup differences in atrial fibrillation incidence, despite significant differences in atrial size.

Finally, the incidence of moderate to severe coronary artery stenosis was significantly higher in both hypertensive groups, but no difference was found between the 2 types of hypertension. We concluded that both systolic and diastolic hypertension contributed to the genesis of left ventricular hypertrophy, left atrial dilatation, coronary sclerosis and congestive heart failure.

Additional Indexing Words:
Left atrial dilatation Congestive heart failure Coronary sclerosis Atrial fibrillation Systolic hypertension Diastolic hypertension Hypertensive heart disease

THE issue of whether the increased incidence of systolic hypertension in the elderly is a physiological aging process or a consequence of athero-
sclerotic changes has been controversial.\textsuperscript{1)–4)}

However, recent studies have shown that even isolated systolic hypertension is associated with higher morbidity and mortality from cardiac failure or cerebrovascular diseases.\textsuperscript{5,6)} We have reported that systolic hypertension in the elderly produced more severe arteriosclerotic changes in the coronary arteries, cerebral arteries and aorta than in normotensive patients.\textsuperscript{7)} Left ventricular hypertrophy, which occurs in even mild cases and is a frequent precursor of congestive heart failure, has been shown to be an early finding in hypertension. The purpose of this paper is to study the relation between systemic hypertension, left ventricular hypertrophy and congestive heart failure.

**Subjects and Methods**

This study utilized a series of 2,010 cases autopsied consecutively at Tokyo Metropolitan Geriatric Hospital from 1972 to 1983. Cases of myocardial infarction, valvular disease, conduction disturbance and myocardial disease were excluded. The cases were divided into 3 groups according to blood pressure before the onset of cardiovascular complications or malignancy.

1) Normotensive group (NT). These cases displayed a systolic blood pressure below 160 mmHg and a diastolic blood pressure below 90 mmHg. This group was comprised of 972 cases (males: 548, females: 424, mean age: 79.5 years).

2) Systolic hypertension group (SHT). These cases displayed a systolic pressure over 160 mmHg and a diastolic pressure below 90 mmHg. This group was comprised of 313 cases (males: 160, females: 153, mean age: 81.6 years).

3) Diastolic hypertension group (DHT). These cases had a diastolic pressure of 90 mmHg or more. The group contained 725 cases (males: 367, females: 358, mean age: 79.7 years).

The weight of the heart was measured and the grade of left ventricular hypertrophy and left atrial dilatation was classified as; severe, moderate, mild and minimal by macroscopic observation. The coronary sclerotic index was also defined as previously described by Kuramoto et al.\textsuperscript{7)} Antemortem findings, such as congestive heart failure (CHF), atrial fibrillation and cardiothoracic rate (CTR) were obtained from the patients clinical charts and analyzed with reference to the blood pressure. The case was classified as if the diagnosis of CHF was in the clinical chart.

Statistical analysis was carried out by the Mann-Whitney test.
Results

The distribution of the heart weight and the grade of LVH in each blood pressure category group are illustrated in Fig. 1a and b. A heart weight over 350 grams was found in 20.1% of NT, in 27.7% of SHT and in 32.1% of DHT cases, with a significant difference between NT and both hypertensive groups (p<0.05). Severe left ventricular hypertrophy was observed in 6.0% of NT cases, in 9.9% of SHT cases and in 11.0% of DHT cases, with a significant difference between NT and both hypertensive groups (p<0.05). No significant difference was found between SHT and DHT. A severely dilated left atrium was observed in 8.4% of NT cases, in 11.8% of SHT cases and in 11.5% of DHT cases, with significant differences between NT and both hypertensive conditions (p<0.05, Fig. 2). Moderate to severe coronary stenosis was found in 32.9% of NT cases, in 53.0% of SHT cases and in 51.7% of DHT cases, showing an increase in coronary stenosis with blood pressure elevation (Fig. 3).

The incidences of congestive heart failure (CHF) in SHT and DHT groups were 18.5% and 16.0%, respectively, and were significantly higher
Fig. 2. The distribution of graded left atrial (LA) enlargement in each group. - no LA enlargement, ± slight, + mild, ++ more than moderate.

than 11.2% in NT (p<0.05, Fig. 4a). Similarly, the prevalence of above 60% CTR was 18.9% in the NT group, 22.8% in the SHT group and 25.4% in the DHT group, with significant differences between NT and both hypertensives (p<0.05, Fig. 4b).

The incidences of intermittent or persistent atrial fibrillation in each group are shown in Table I. There were no significant differences in the incidences among the groups.

**DISCUSSION**

In the past, systolic hypertension has been considered as a consequence of a rigid, arteriosclerotic aorta and its major branches. However, several recent studies indicated mild or isolated systolic hypertension in the elderly is related to cardiac failure and cerebral hemorrhage. The Framingham study showed that elderly subjects with isolated systolic hypertension experienced 3 to 4 times the cardiovascular morbidity as normotensives. These findings were independent of the degree of arterial rigidity, a physiological change accompanying aging.
Kuramoto et al.\(^7\) reported no significant differences in the effects of systolic or diastolic hypertension on arteriosclerotic changes in cerebral arteries, the aorta and coronary arteries. Terasawa et al.\(^10\) also showed that systolic blood pressure in the aged had a positive correlation with aorta, cerebral, renal and coronary atherosclerosis. Thus, systolic hypertension in the aged cannot be disregarded from the viewpoint of cerebrocardiovascular events.

There is little doubt that left ventricular hypertrophy is an inevitable compensatory outcome of long-standing hypertension. The present study has shown that systemic hypertension in the aged, regardless of whether it is systolic or diastolic, elicits cardiac structural changes, such as left ventricular hypertrophy and left atrial enlargement. These factors may be related to functional deterioration; i.e., to congestive heart failure. Indeed, the prevalence of congestive heart failure and increased CTR were higher in both types of hypertension compared with normotensives. Similarly, the Framingham study reported that 75\% of the cases of CHF were preceded by systemic hypertension.\(^11\) Of interest is the finding that the development of LVH at autopsy correlated better with systolic than with diastolic blood pressure.
Fig. 4. The prevalence of clinical symptoms of congestive heart failure (a) and the grade of CTR on chest X-ray (b).

Table I. The Prevalence of Paroxysmal and Persistent Atrial Fibrillation in 3 Groups

<table>
<thead>
<tr>
<th>Atrial fibrillation</th>
<th>Normotension</th>
<th>Systolic hypertension</th>
<th>Diastolic hypertension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persistent</td>
<td>66 (6.8%)</td>
<td>19 (6.1%)</td>
<td>58 (8.0%)</td>
</tr>
<tr>
<td>Paroxysmal</td>
<td>46 (4.7%)</td>
<td>25 (8.0%)</td>
<td>41 (5.7%)</td>
</tr>
<tr>
<td>Not present</td>
<td>860 (88.5%)</td>
<td>269 (85.9%)</td>
<td>626 (86.3%)</td>
</tr>
<tr>
<td>Total</td>
<td>972</td>
<td>313</td>
<td>725</td>
</tr>
</tbody>
</table>

Only a few studies have examined the relationship between mild hypertension in the elderly and left ventricular hypertrophy. Murata et al.\(^\text{12}\) showed that 69% of hypertensive elderly patients with a systolic blood pressure greater than 180 mmHg had left ventricular hypertrophy. However, since no significant correlation was found between the degree of coronary arterial stenosis and the grade of left ventricular hypertrophy, they concluded that blood pressure itself may be a major contributing factor to the development of left ventricular hypertrophy. In the present study, the incidence of moderate to severe coronary artery stenosis was higher in both hypertensive groups compared with normotensives and we could not isolate coronary artery
stenosis from blood pressure as a contributing factor to left ventricular hypertrophy.

It was indicated by Dunn et al\textsuperscript{13} that significant left atrial enlargement provides initial evidence of left ventricular dysfunction. Indeed, the present study demonstrated that even elderly patients with isolated systolic hypertension had a significantly enlarged left atrium compared with normotensive patients, although the prevalence of atrial fibrillation was identical. Thus, our study suggests that even isolated systolic hypertension in the aged should be treated, because it may cause left ventricular hypertrophy and left atrial enlargement.

\textbf{References}